A Study on the Development of Open Source-Based Image Mosaicking Software

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Abstract: Image mosaicking can be handled by ENVI, Erdas Imagine, ArcGIS and other commercial software, but they are designed centering on the implementation of functions, resulting in producing very different outputs depending on the user's software handling skills. Thus, there is a need to develop automatic image mosaicking software based on the map sheet. This study presents the development of the automatic mosaicking and color correction software for the national land satellite information under the project of establishment and operation of the satellite information utilization center, and also conducts the development of color correction algorithm. The color correction used the histogram matching method. In order to check the image stretching state of the NIR bands of N number of images in a different color distribution, the standard deviation of each NIR band was calculated, and the NIR band with the biggest standard deviation was made to become the reference for selection. The reference NIR was used to correct the color between the other NIR bands, and a merged NIR band was created through image mosaicking. The same method was applied to the color correction of the remaining R, G, and B bands. The color correction algorithm was developed based on the open source GDAL library using Python. This study targeted the low-capacity images, and the function is implemented manually. In order to boost the utilization of satellite images in the development of a color correction algorithm, the accuracy should be verified and the speed improvement and other relevant algorithms should be improved according to standard deviations, targeting the N number of large-capacity images so as to automate the function.

Keywords: Color Correction, Histogram, NIR Band, Python, Standard Deviation

1. Introduction

South Korea's next generation medium-sized satellites No. 1 and No. 2, scheduled for launch in 2019 and 2020, respectively, are aimed for homeland observation. Currently, the task of establishing satellite information utilization center and developing utilization technology is in progress to support efficient utilization of the satellites. As part of the efforts to establish and operate the satellite information utilization center, the development of satellite mosaicking and color correction automation software is underway.

Image mosaicking is processed in commercial SOFTWARE such as ENVI, Erdas Imagine, ArcGIS. As they are designed with a focus on function implementation, however, they show very different result depending on user's SOFTWARE proficiency. Therefore, this study introduces the development of image mosaicking SOFTWARE, which is a part of

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satellite information collection and utilization technology, to support efficient utilization of the next generation medium-sized satellites.

2. Image mosaicking SOFTWARE

2.1. Color Correction Algorithm

In general, the brightness value of each band of two or more images in the same region may be different since satellite images have different weather conditions and shooting time. As a result, the brightness value of pixels in each region may not be uniform within the image when a single image is created by combining several images.

In an optical image composed of multiple spectroscopic bands, it is near infrared band (NIR) that has the sharpest difference in brightness values of various objects. Therefore, the NIR band with relatively good image stretching was set as the reference band by comparing the brightness values of the NIR bands of N images, while the brightness values of the remaining NIR bands were accumulated using a cumulative distribution function (cdf) in order to carry out calibration. At this time, the standard deviation of each NIR band was calculated in order to check the image stretching state of the NIR bands of N images, and the NIR band having the largest standard deviation value

was selected as the reference band.

In the case of the red / green / blue band, the red / green / blue band of the image to which the reference NIR band belongs was set as the reference band, and color correction was performed in the same manner as the NIR band.
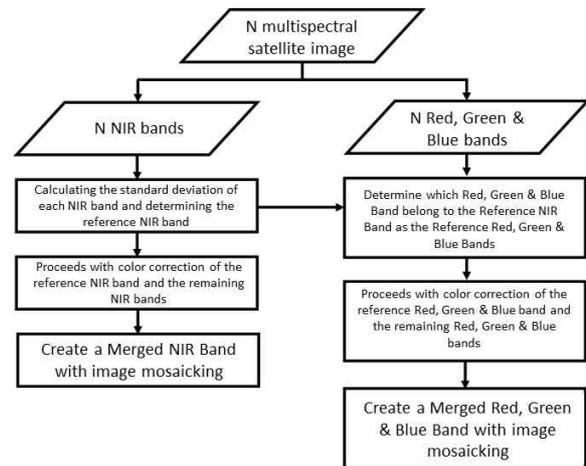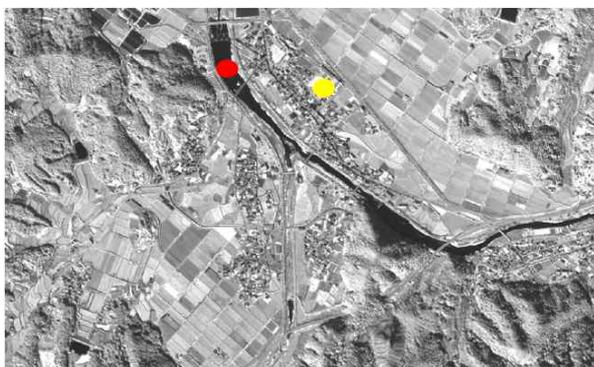

Figure 1. Color correction algorithm flowchart

It can be confirmed that due to weather conditions such as clouds and shooting time, the object (a), which was blurred in the band image, caused image stretching effect after the color correction based on the cdf method, and the image's sharpness was much improved in the color-corrected band (b).

    (a)   Before color correction (NIR Band)

Red: Water, dark areas, pixel brightness values 1,230

Yellow: Land, bright areas, pixel brightness values 7,488
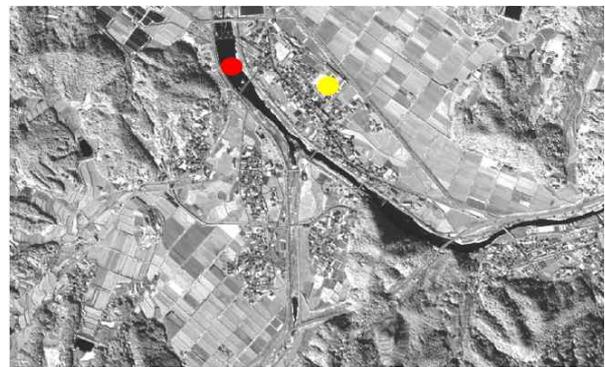
    (b)   Before color correction (NIR Band)

Red: Water, dark areas, pixel brightness values 1,229

Yellow: Land, bright areas, pixel brightness values 9,508

Figure 2. Examples of color correction

2.2. Mosaicking SOFTWARE development

The painter's algorithm, a method used in ArcGIS, was used when producing multiple bands with color correction. The painter's algorithm selects pixel values of merge bands in the order of first input band.
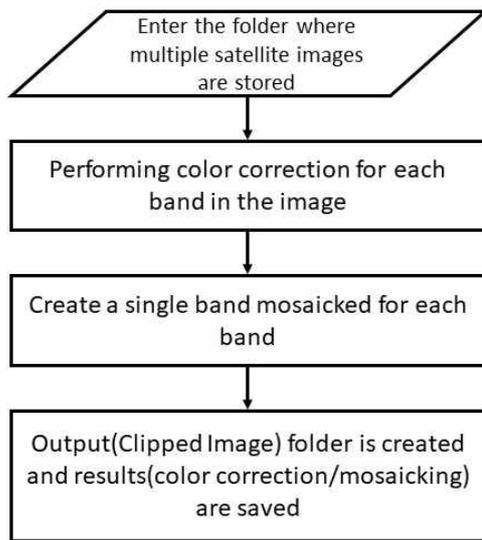

Figure 3. Mosaicking SOFTWARE development flowchart

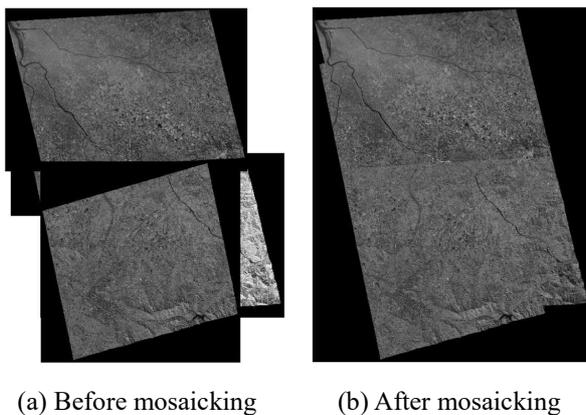(a) Before mosaicking   (b) After mosaicking

Figure 4. Mosaicking example

2.3. Clipping function

We designed an algorithm that can clip the images included in each leaf by using 1: 5,000 leaf and high resolution Arirang satellite image. Geospatial data processing technology of satellite images and GIS shape file was developed using a variety of open source libraries such as geopandas, rasterio, shapefile, Fiona along with Python. We designed the path of satellite image data including all bands (Red, Green, Blue, NIR) as well as an UI that allows cutting all bands of each image by foliage with the click of a button and using Python-based QT library.

3. Conclusion

As part of the effort to establish and operate the satellite information utilization center, we developed SOFTWARE for mosaicking and color correction automation. Color correction and mosaicking automation were implemented, followed by addition of clipping function of each leaf using 1: 5,000 leaves, and the function implementation by system development was confirmed through simple UI.

In the future, the system will be upgraded and the UI will be advanced, thereby supporting the efficient use of the next generation mid-satellite satellites 1 and 2 through the development of application technology such as satellite image precision correction technology including image mosaicking SOFTWARE development.

References

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